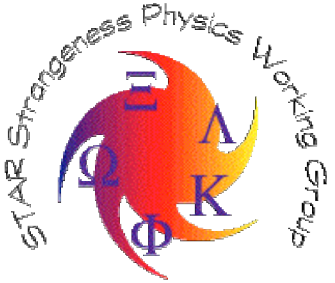


THE UNIVERSITY
OF BIRMINGHAM

Identified Particle Ratios at large p_T in Au+Au collisions at $s_{NN} = 200$ GeV

Matthew A. C. Lamont

for the STAR Collaboration

- Talk Outline -

Physics Motivation

Current Models

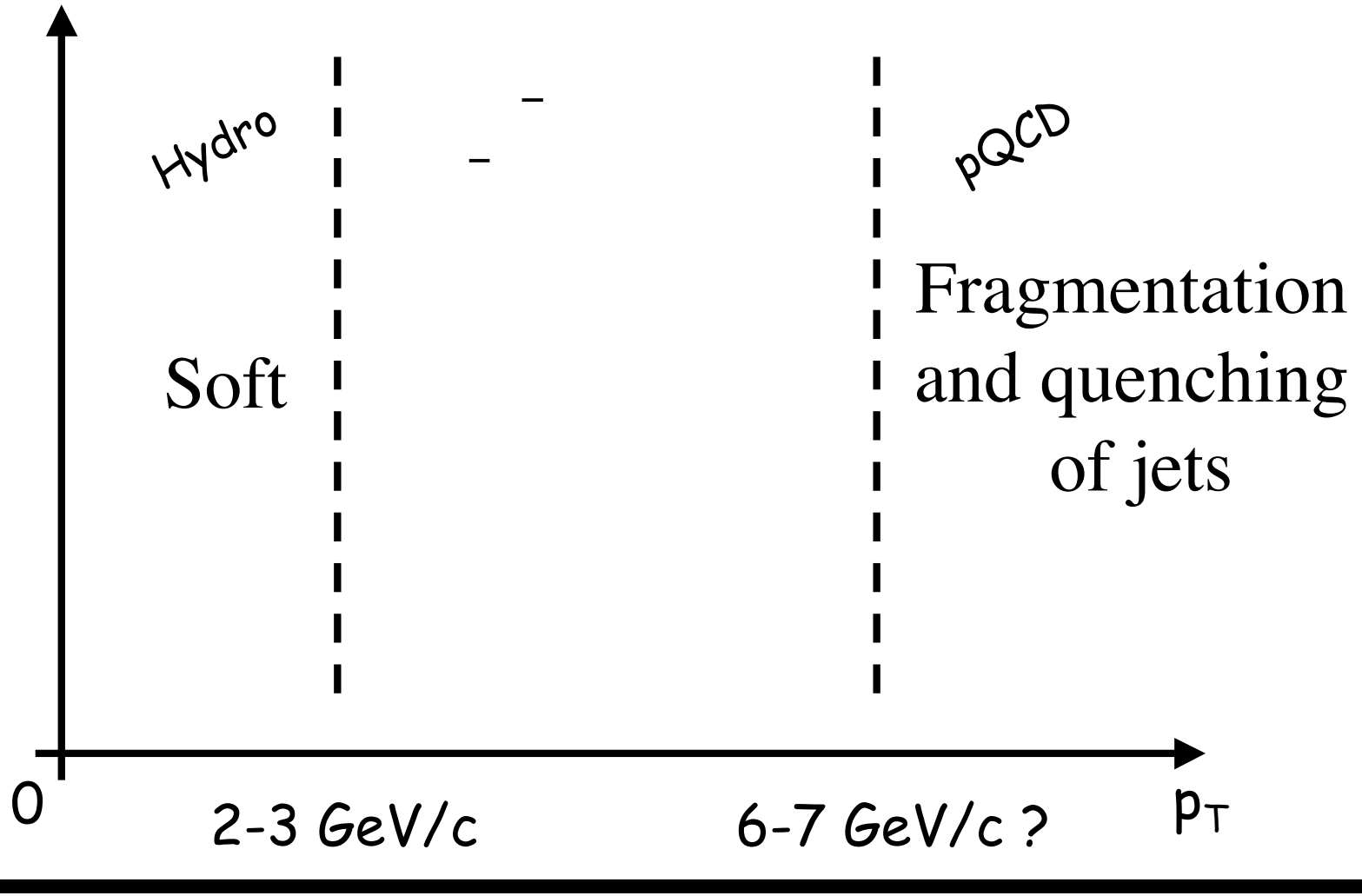
Identified Particle Spectra

$\bar{B}$/B and B/M ratios

Strange Particle Correlations

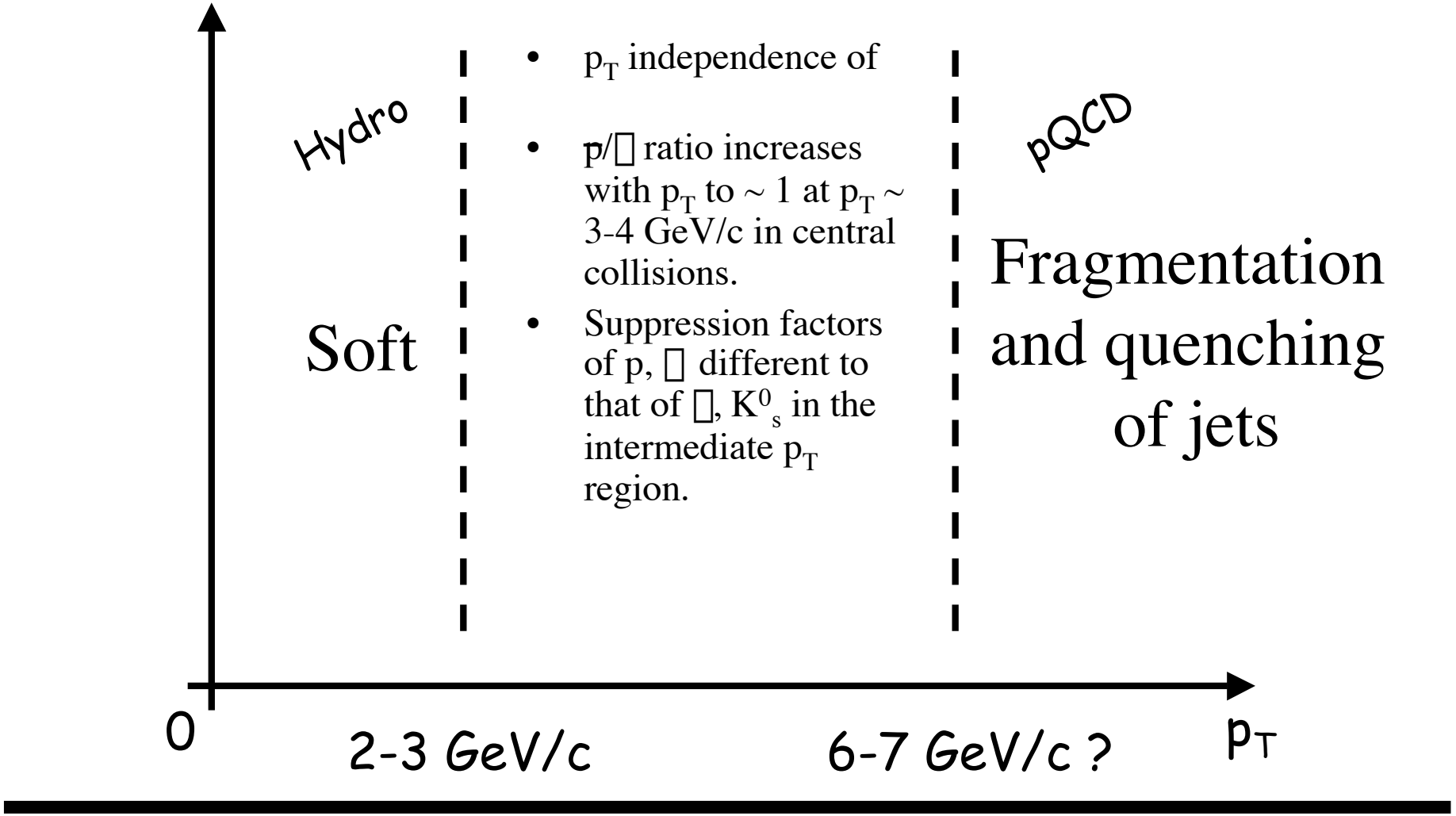
Motivation : Particle production vs p_T

What do we think we know ?



Motivation : Particle production vs p_T

What has the data already shown us at intermediate p_T ?



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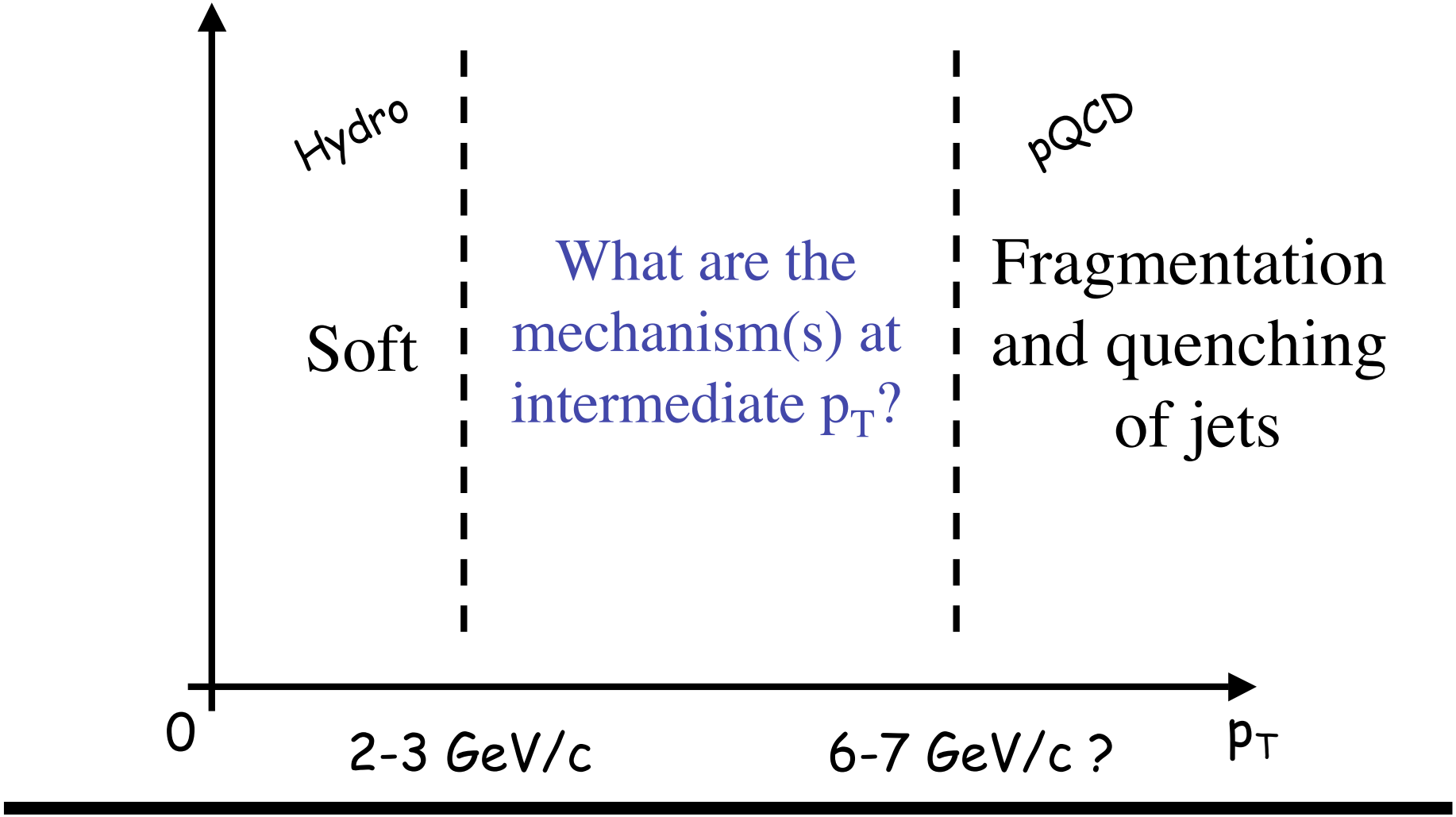
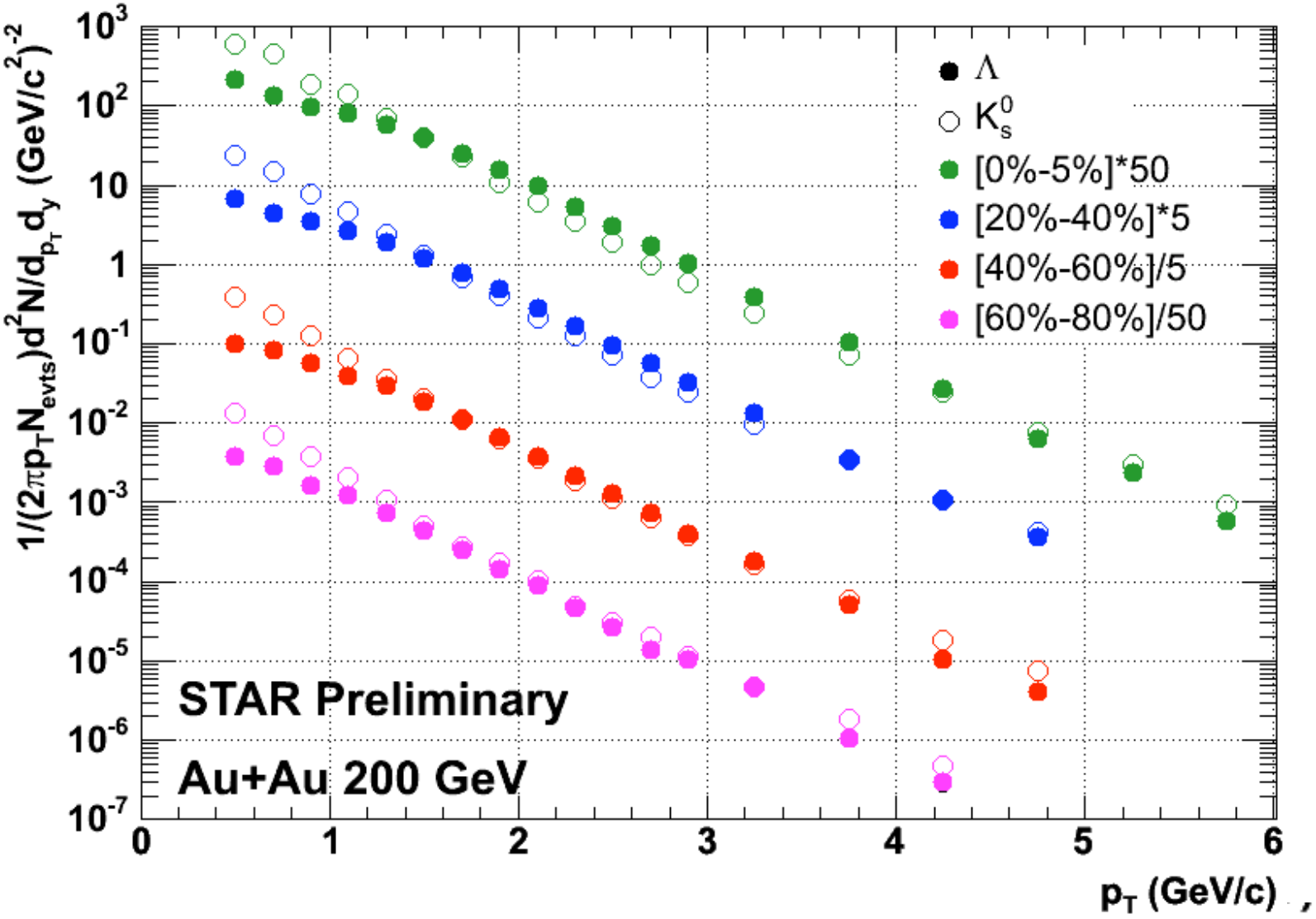


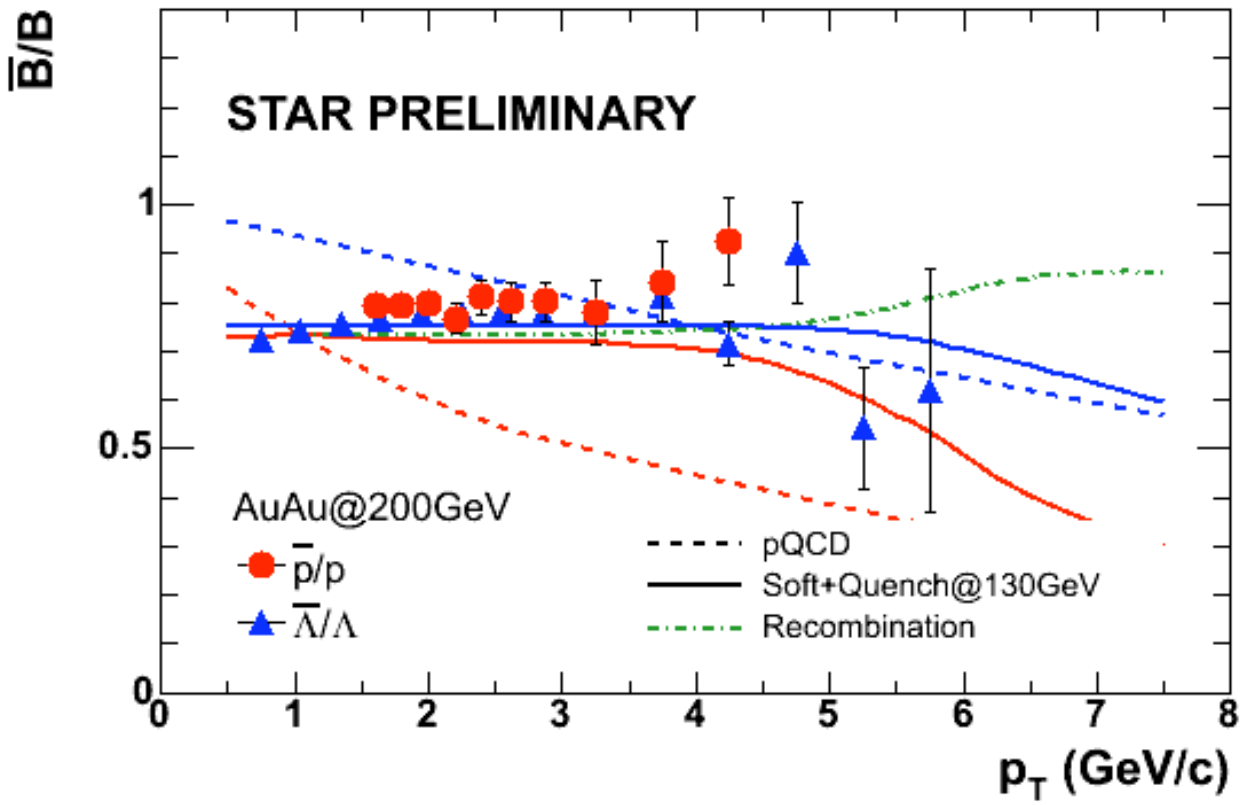
Current theoretical models

- **Soft + Quench Model** M. Gyulassy *et. al.*, Phys. Rev. Lett. **86** (2001) 2537
  - Two component model, soft production (hydro) at low p_T, quenching of pQCD jets via gluon radiation at higher p_T.
    - Baryon junctions incorporated to explain large baryon yield at intermediate p_T.
- **Recombination** R. J. Fries *et. al.*, Phys. Rev. C **68** (2003) 044902
  - Model assumes the recombination of two and three low p_T partons to form hadrons from an exponential parton p_T spectrum. High p_T spectrum described by fragmentation once parton p_T spectrum can be described by a power law.
    - Requires a high phase space density of partons for method to work.
- **Coalescence** V. Greco *et. al.*, Phys. Rev. C **68** (2003) 034904
  - Same as the recombination picture with the added assumption that thermal 'QGP' partons can coalesce with co-moving 'pQCD' partons from a mini-jet.

Identified particle spectra : p, $\bar{p}$, $K^{-,+}$, $\Omega^{-,+}$, K^0_s and Ω



$\bar{B}/B$ ratios vs Transverse Momentum (p_T)



This pQCD calculation fails : uncertainties in PDFs and fragmentation functions ?

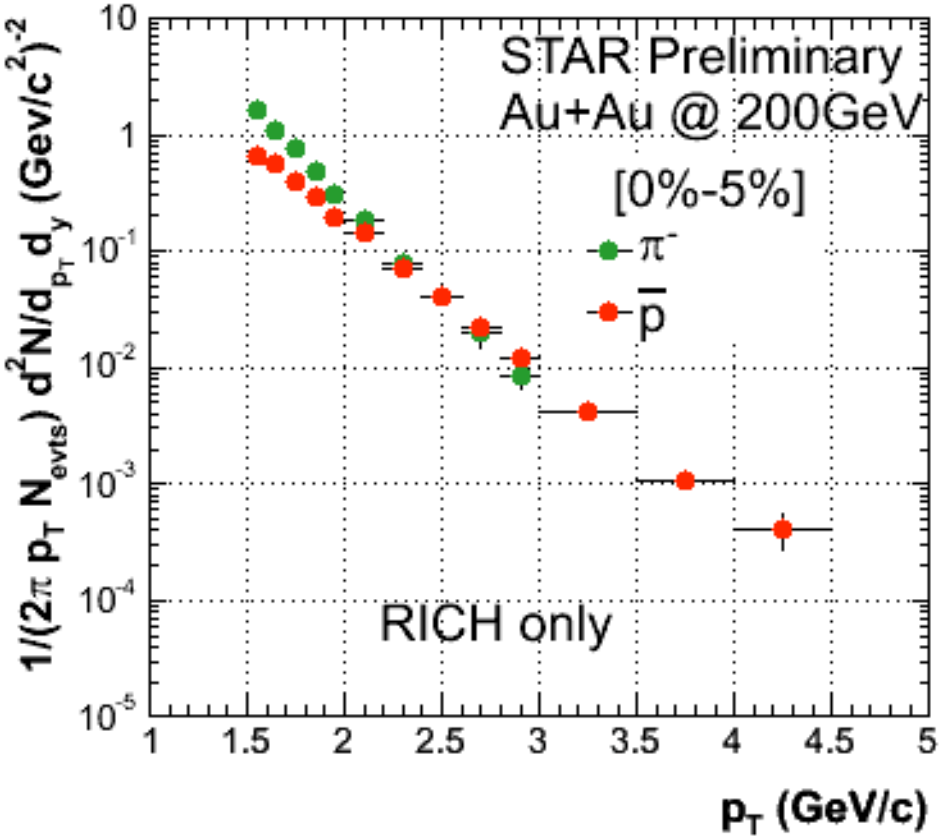
Both the 'Soft+Quench' and recombination model predictions are consistent with the data.

Soft+Quench (130 GeV) : Nucl. Phys. A**715** 779-782 (2003)

Recombination (200 GeV) : Phys. Rev. C**68** 044902 (2003)

Note the different trend in the $\bar{p}/p$ ratio from that reported in Nantes. Experimental effects have been better modelled (mainly space charge distortions).

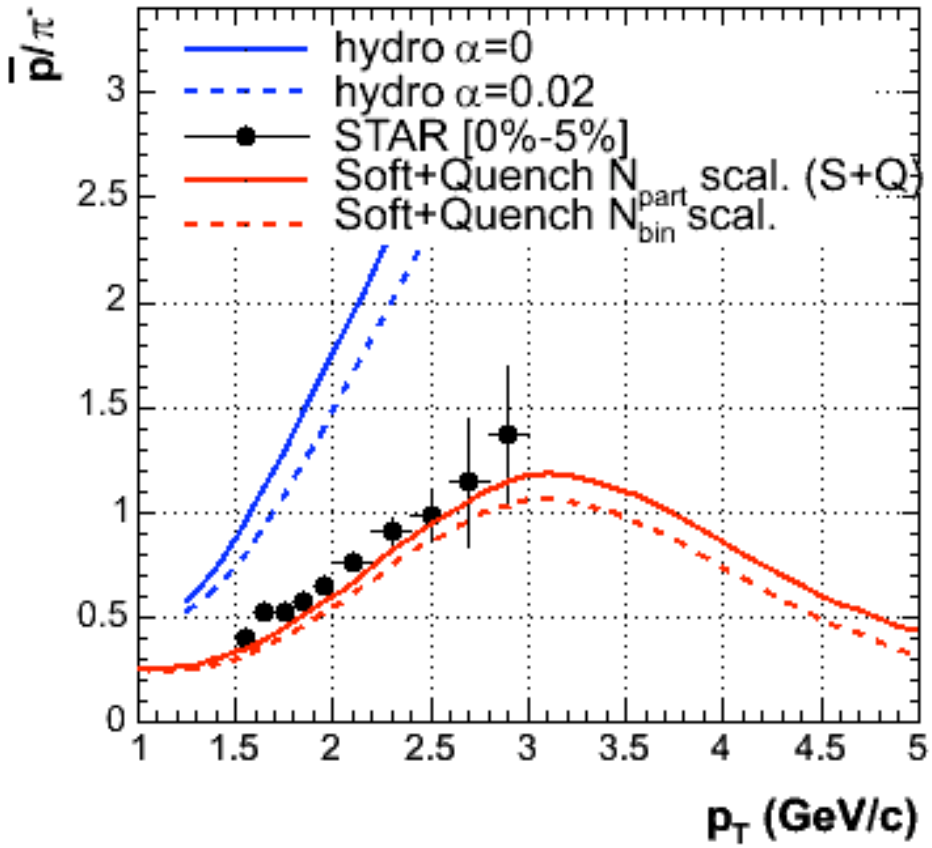
$\bar{p}/\pi^-$ ratios, data and theory



Note that $\bar{p}$ data is not corrected for feed-down from weak decays $\Rightarrow$ $\bar{p}/\pi$ ratio will decrease.

Hydro: Phys. Rev. C**67**, 044903 (2003)
S+Q: 200 GeV data - private communication
S+Q: 130 GeV data - Phys. Rev. C**65**, 041902

$\bar{p}/\pi^-$ ratios, data and theory



- **S+Q** : magnitude ✓
  low p_T ✓
- **Hydro** : magnitude ✗
  low p_T ✗
- **Reco** : magnitude ✓ ✗
  low p_T ✗
- **Coal** : magnitude ✓
  low p_T ✓

Note that $\bar{p}$ data is not corrected for feed-down from weak decays $\bar{p}/$ ratio will decrease.

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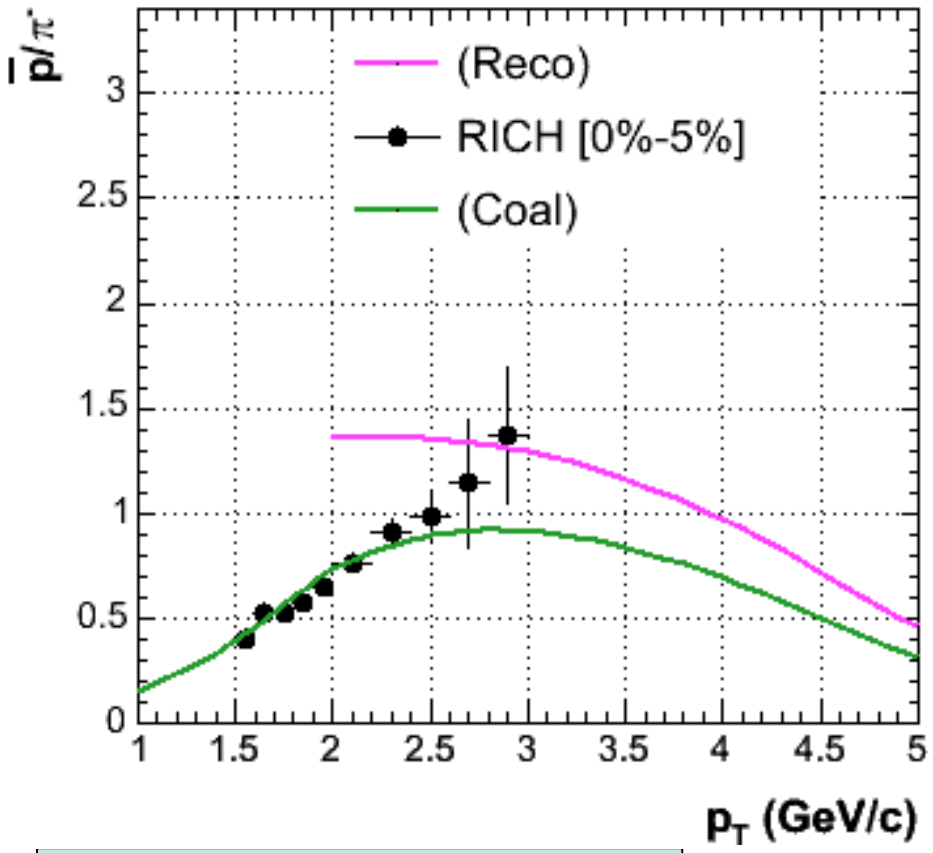

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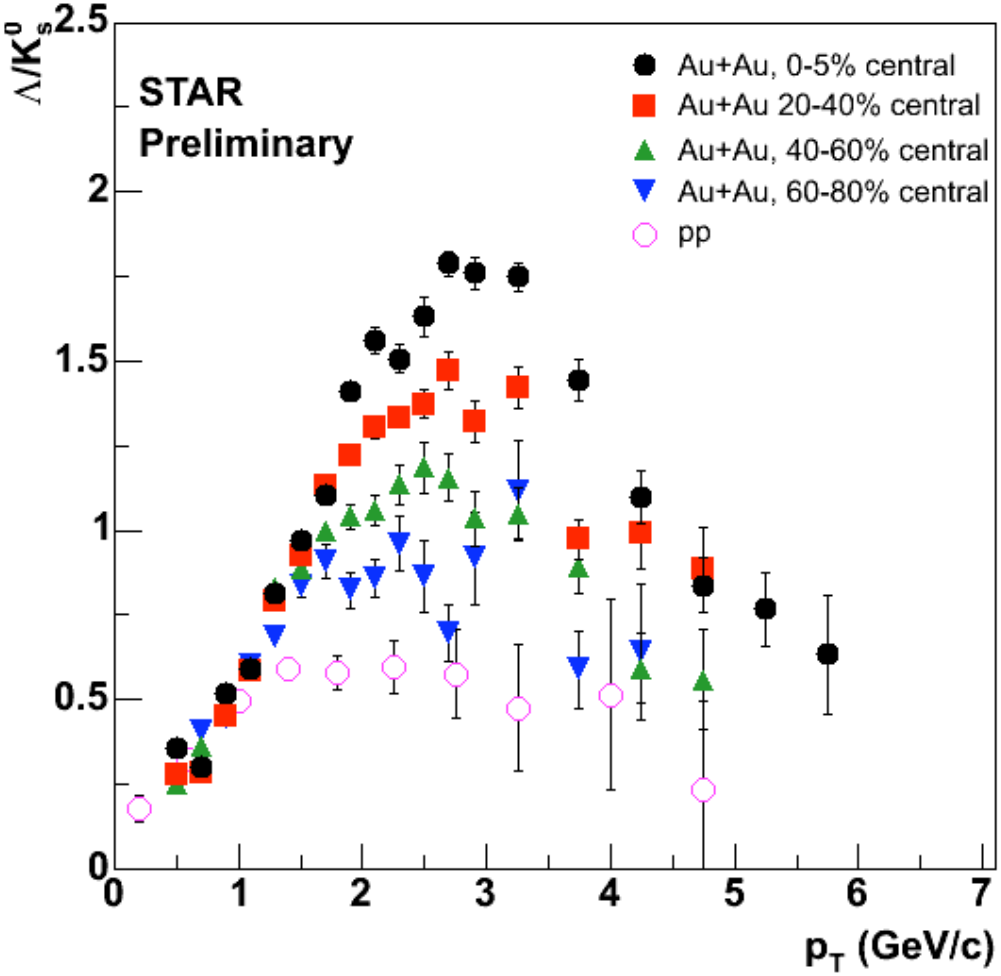
Reco : Phys. Rev. C**68** 044902 (2003)
Coal : Phys. Rev. C**68** 034904 (2003)

□/K^0_s ratios vs collision centrality

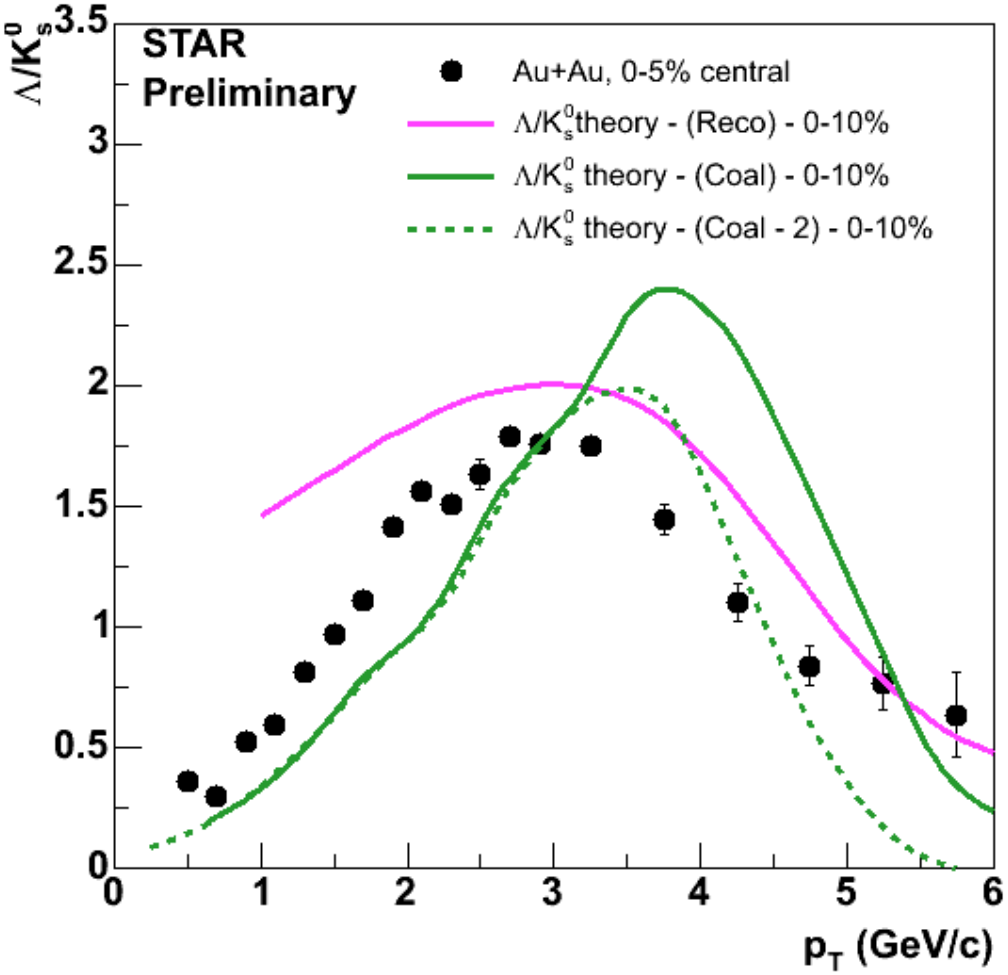


- □/K^0_s ratio increases with increasing centrality
  - peaks in the intermediate p_T region.
  - turns over and appears to tend to the same value for all centralities for p_T ~ 5-6 GeV/c.
  - Therefore p_T range of baryon excess is limited to < 5-6 GeV/c.
  - Not yet down to level in pp data

□ not corrected for feed-down from weak decays - estimated to be a 10% effect and ~ independent of p_T.

For p+p data, refer to poster by M. Heinz and J. Adams

Λ/K^0_s - comparison with models



- **S+Q** : magnitude ✓
  turnover ✓
  centrality ✓
- **Reco** : magnitude ✓
  turnover ✓
  low p_T ✗
- **Coal** : magnitude ✗
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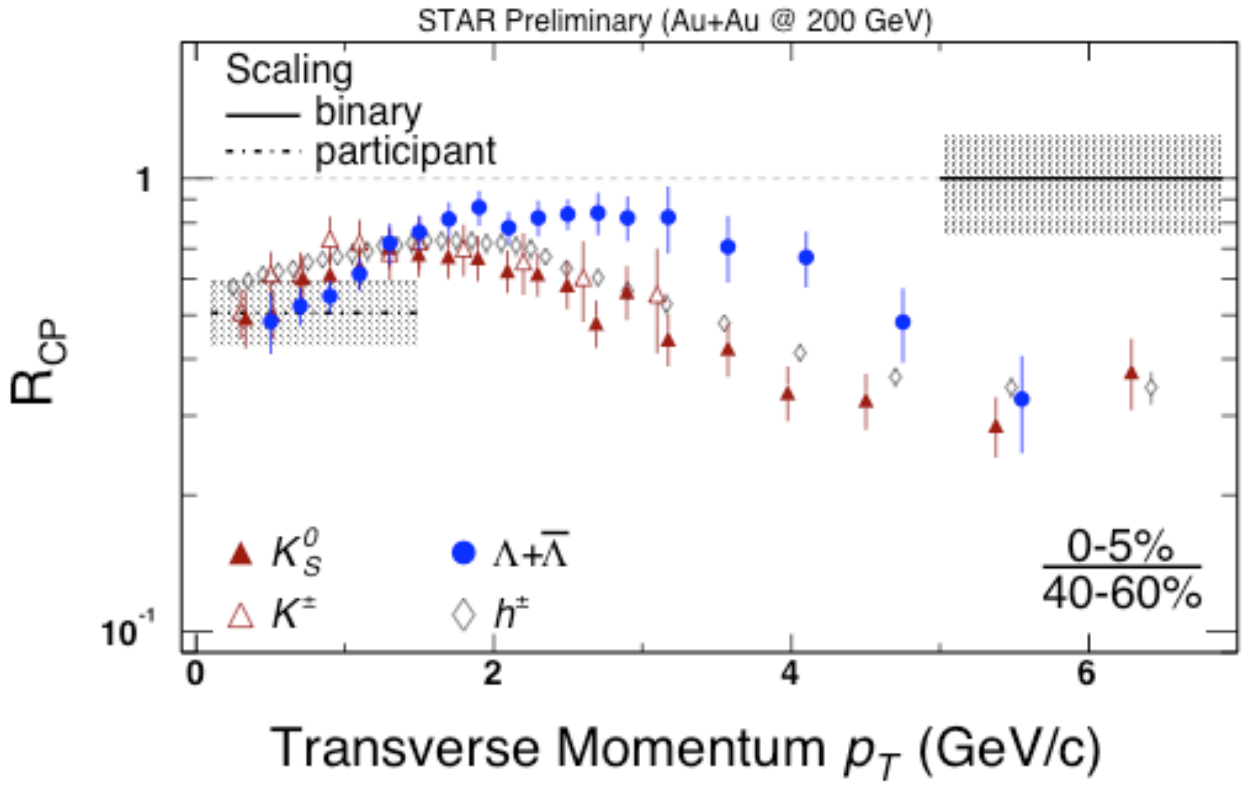
  low p_T ✓

Require centrality dependent prediction from Recombination and Coalescence models.

Reco : Phys. Rev. C**68** 044902 (2003)
Coal : Phys. Rev. C**68** 034904 (2003)

Another view of the same effect? …. R_{cp}



- Suppression of mesons different to baryons - not mass dependent effect.
- R_{cp} of baryons and mesons separate at $p_T \sim 2$ GeV/c and come together at $p_T \sim 5$-6 GeV/c.

See poster by P. Sorensen

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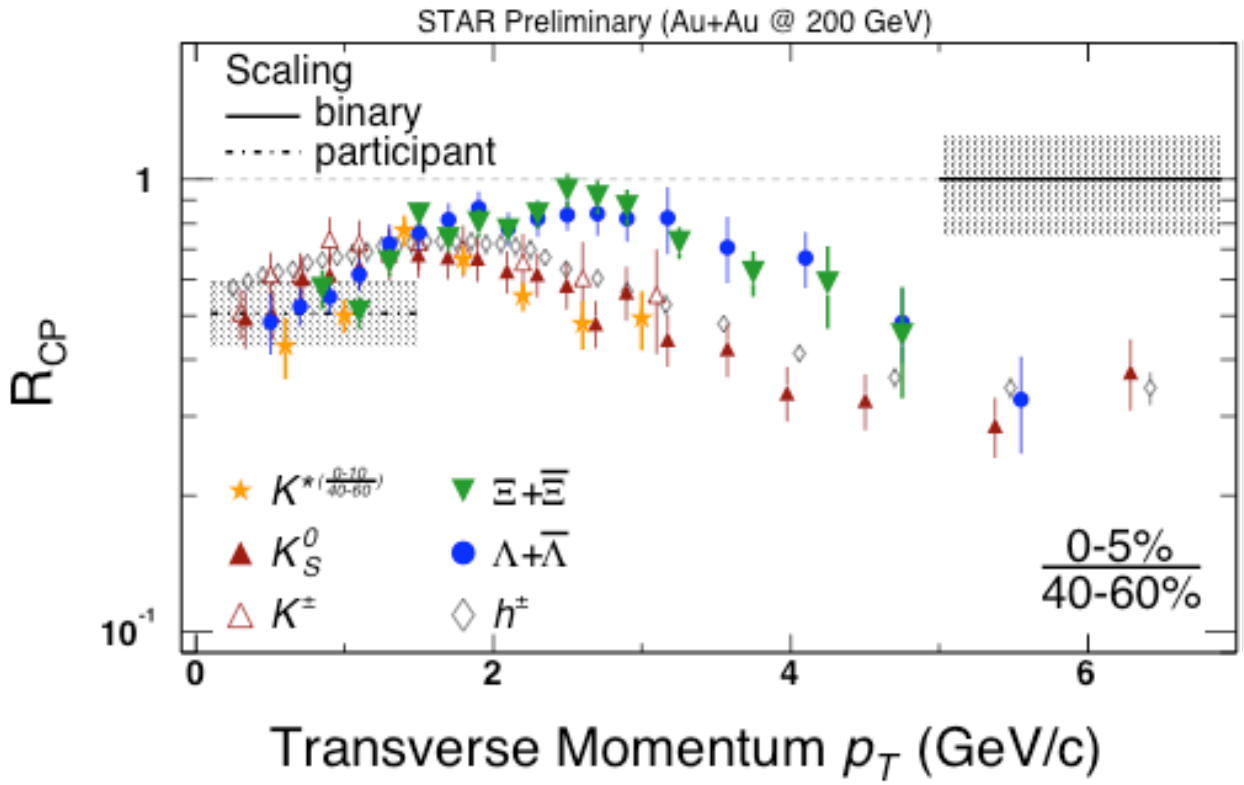

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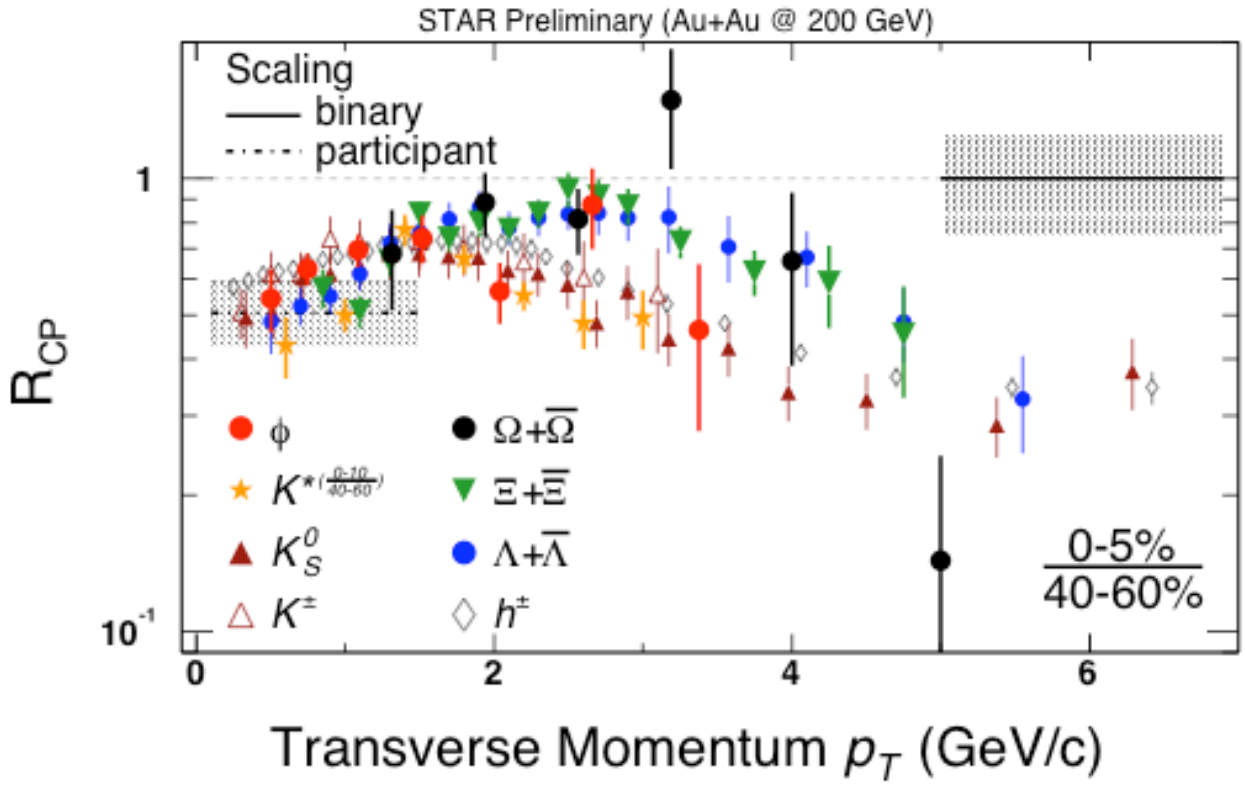

- Suppression of mesons different to baryons - not mass dependent effect.
- R_{cp} of baryons and mesons separate at p_T ~ 2 GeV/c and come together at p_T ~ 5-6 GeV/c.

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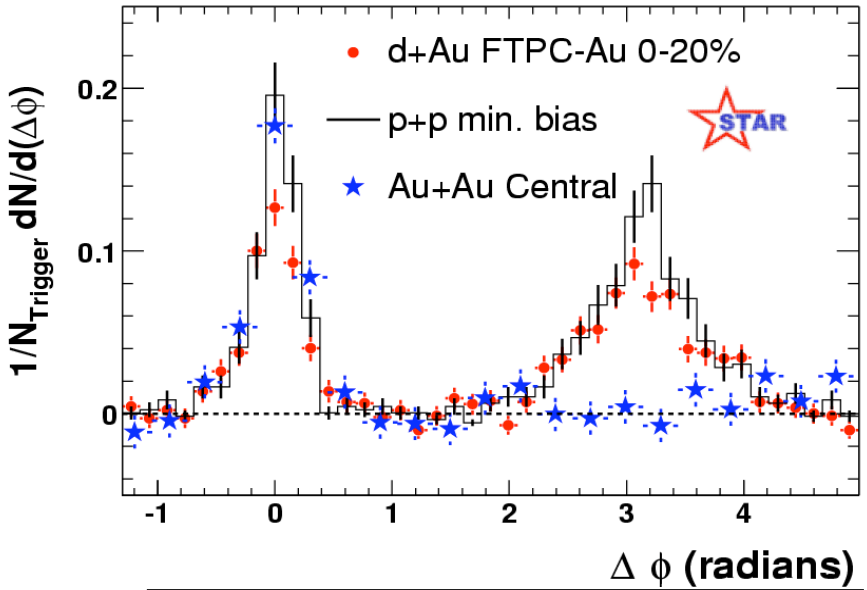
Identified Particle Correlations

- We have seen previously the disappearance of back-to-back jet correlations in central Au+Au, with charged particles.

Back to back jet disappearance for charged trigger particles (Phys. Rev. Lett. 91 072304 (2003))

- Measuring correlations with identified particles could give us insight on possible different production mechanisms for baryons and mesons.

- Correlation appears stronger for □ compared to □̄, though in both cases, there is an absence of a 'back-to-back' partner correlation.



(trigger p_T > 2.5 GeV/, associated p_T > 2.5 GeV/c & less than trigger p_T)

trig: □, assoc : charged hadron

See poster by Y. Guo

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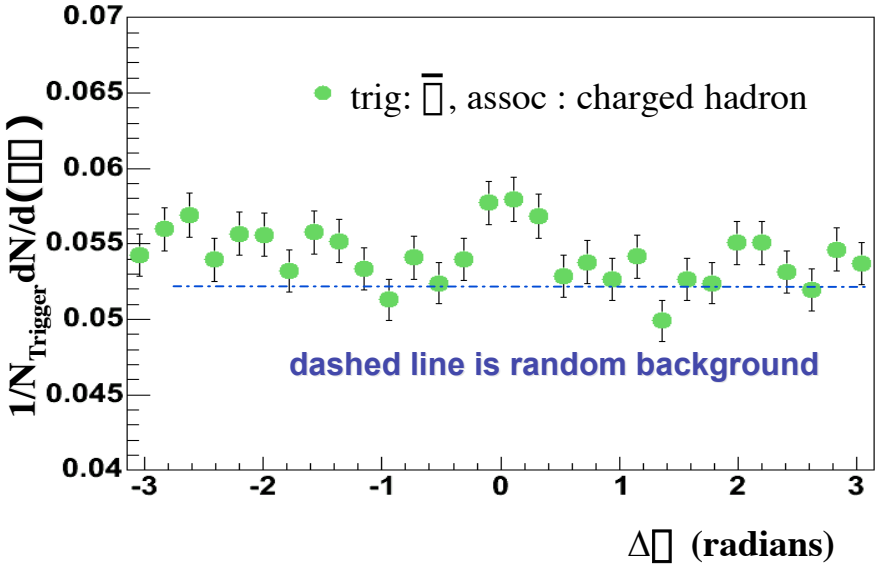
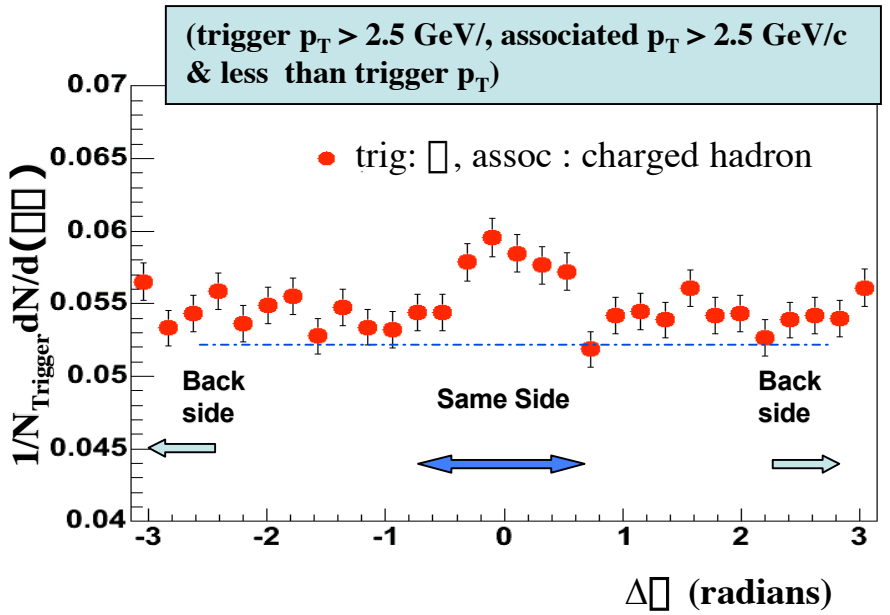




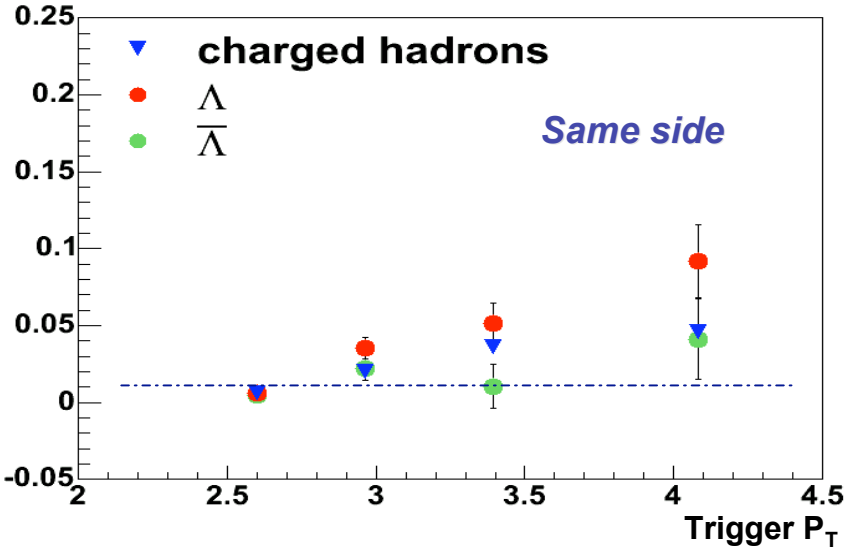
See poster by Y. Guo

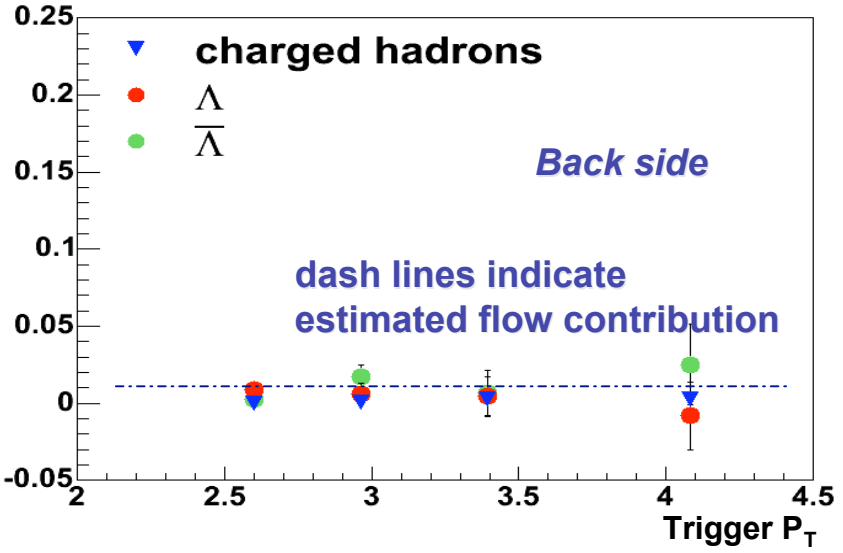
Quantifying the Correlation Strength

$$N_{same} = \frac{\square\ N_{pairs}(|\square\Delta| \square\ 0.65)}{N_{trigger}}$$

$$N_{back} = \frac{\square\ N_{pairs}(|\square\Delta| > 2.49)}{N_{trigger}}$$

- Correlation difference defined as : $N_{same} - N_{back}$





- Suppression of □ as a function of p_T is slightly different from the □̄, K^0_s and primaries.
- Under investigation whether this is an experimental effect or whether there is indeed sensitivity to quenching or production mechanism effects

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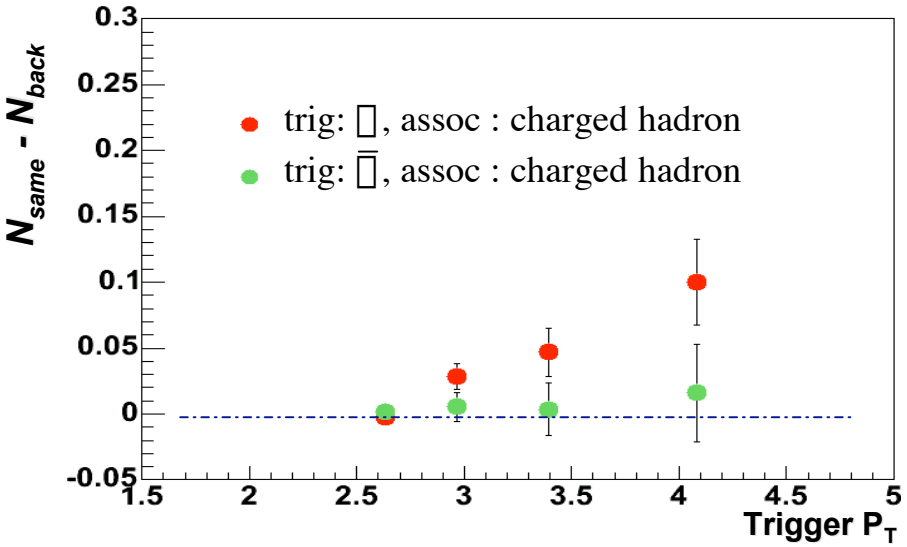

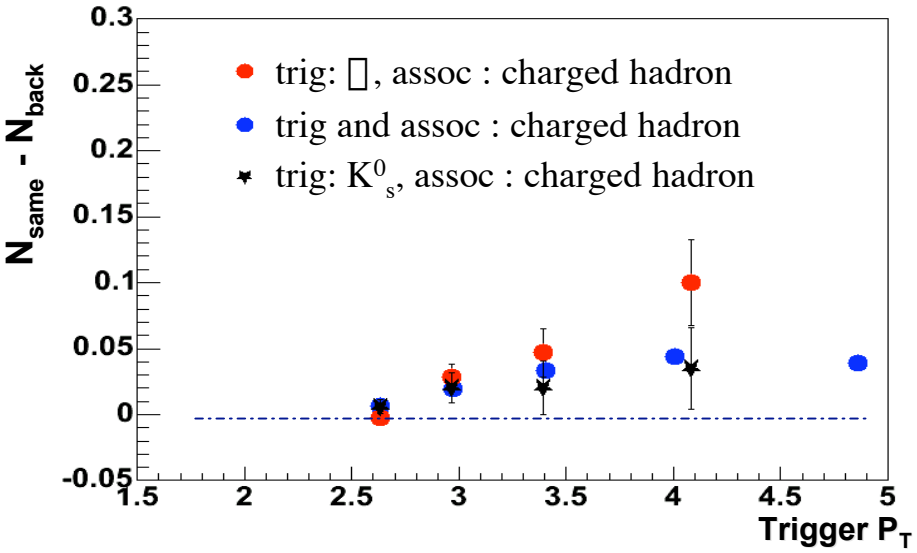

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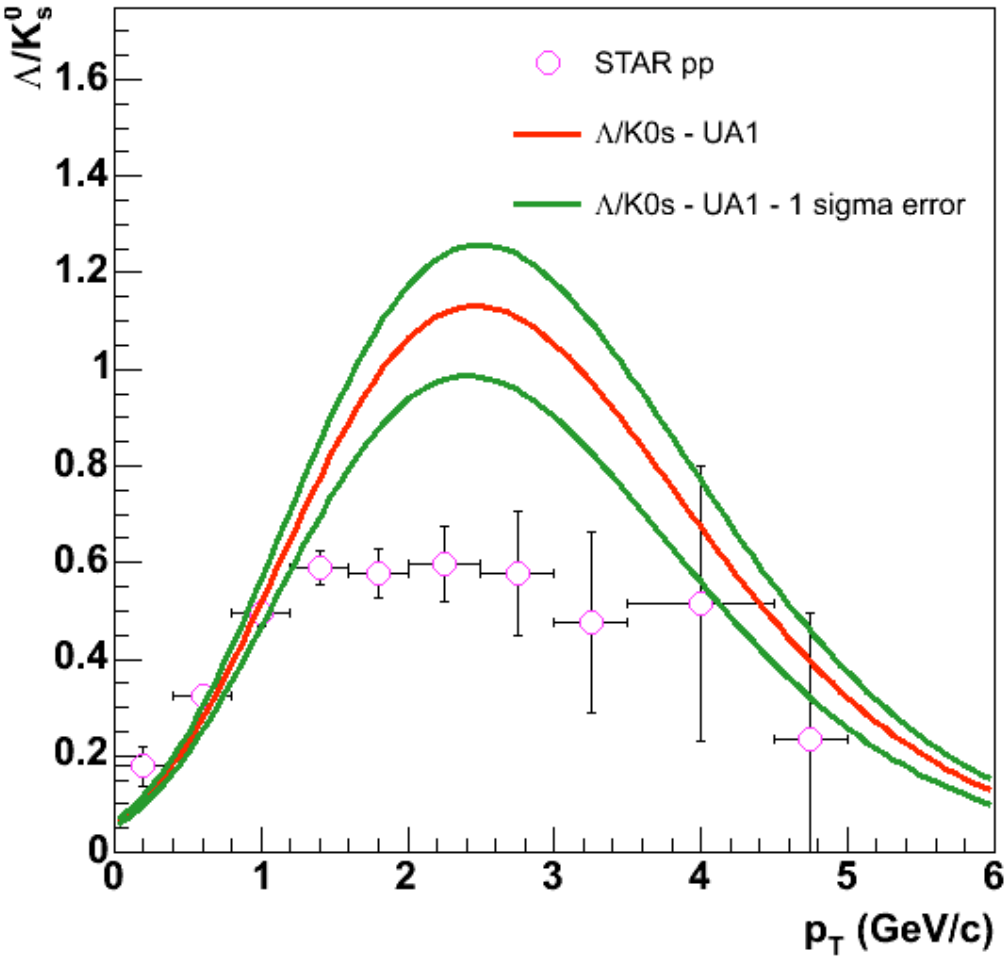
See poster by Y. Guo

Summary

- $\bar{B}/B$ ratios are independent of p_T.
  - pQCD calculation fails : uncertainties in PDFs and fragmentation functions ?
- $\bar{p}/\square$ ratio increases with p_T up to 3 GeV/c.
- $\square/K^0_s$ ratio increases smoothly with centrality, turns over at $p_T \sim 3$ GeV/c.
  - baryon excess over mesons is limited in p_T to < 5-6 GeV/c.
  - A+A value still above p+p value.
- The R_{cp} measurement exhibits differences between baryons and mesons - not just a mass effect.
- Strange correlations hint at a flavour dependence.
  - correlations with $\square$ triggers possibly enhanced over those with $\bar{\square}$ and K^0_s triggers.

Backup Slides

STAR pp vs UA1 $\bar{p}p$

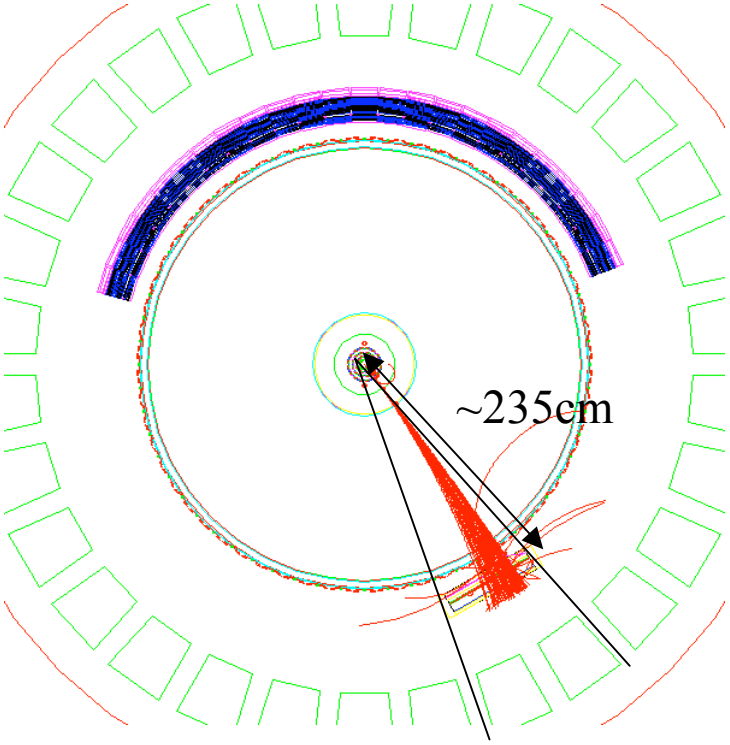


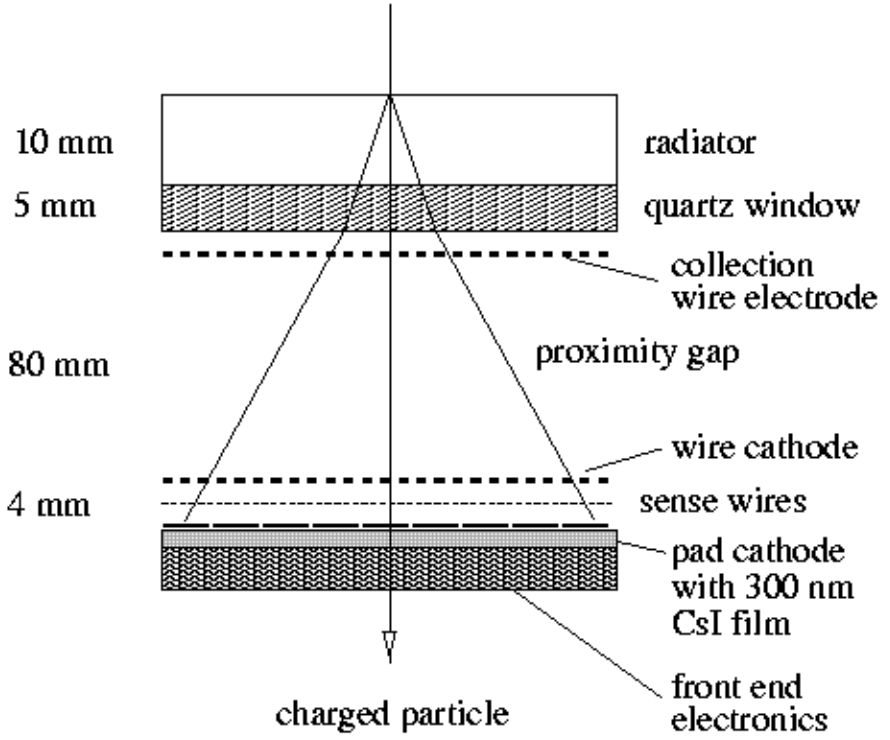
- Ratio very different in two systems
- Different production mechanisms or just differences in experiments ?

	STAR	UA1
Ratio Plotted	Λ/K^0_s	$\Lambda+\bar{\Lambda}/2K^0_s$
Colliding System	p+p	p+p
Energy	200 GeV	630 GeV
Coverage	$\|y\| < 1$	$\|\eta\| < 2.5$

STAR RICH Geometry

|□|<0.3 and □□ = 20□

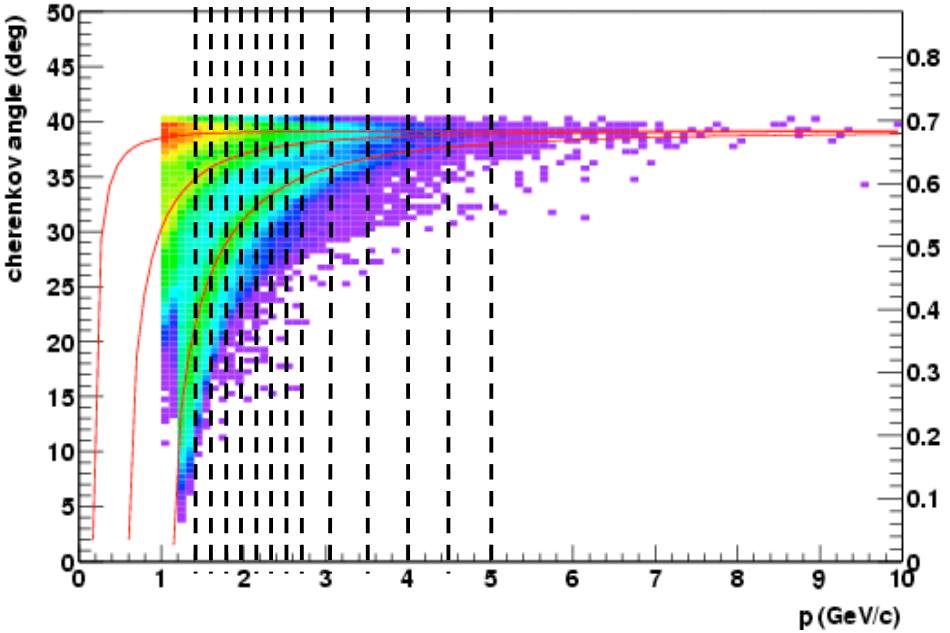


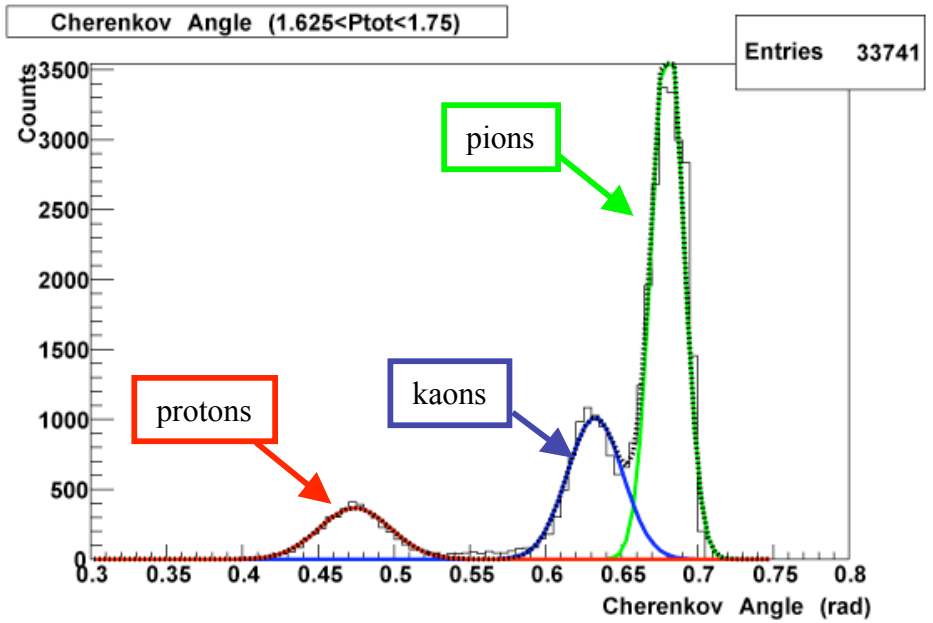


1) Charged particle through radiator
2) MIP and photons detection

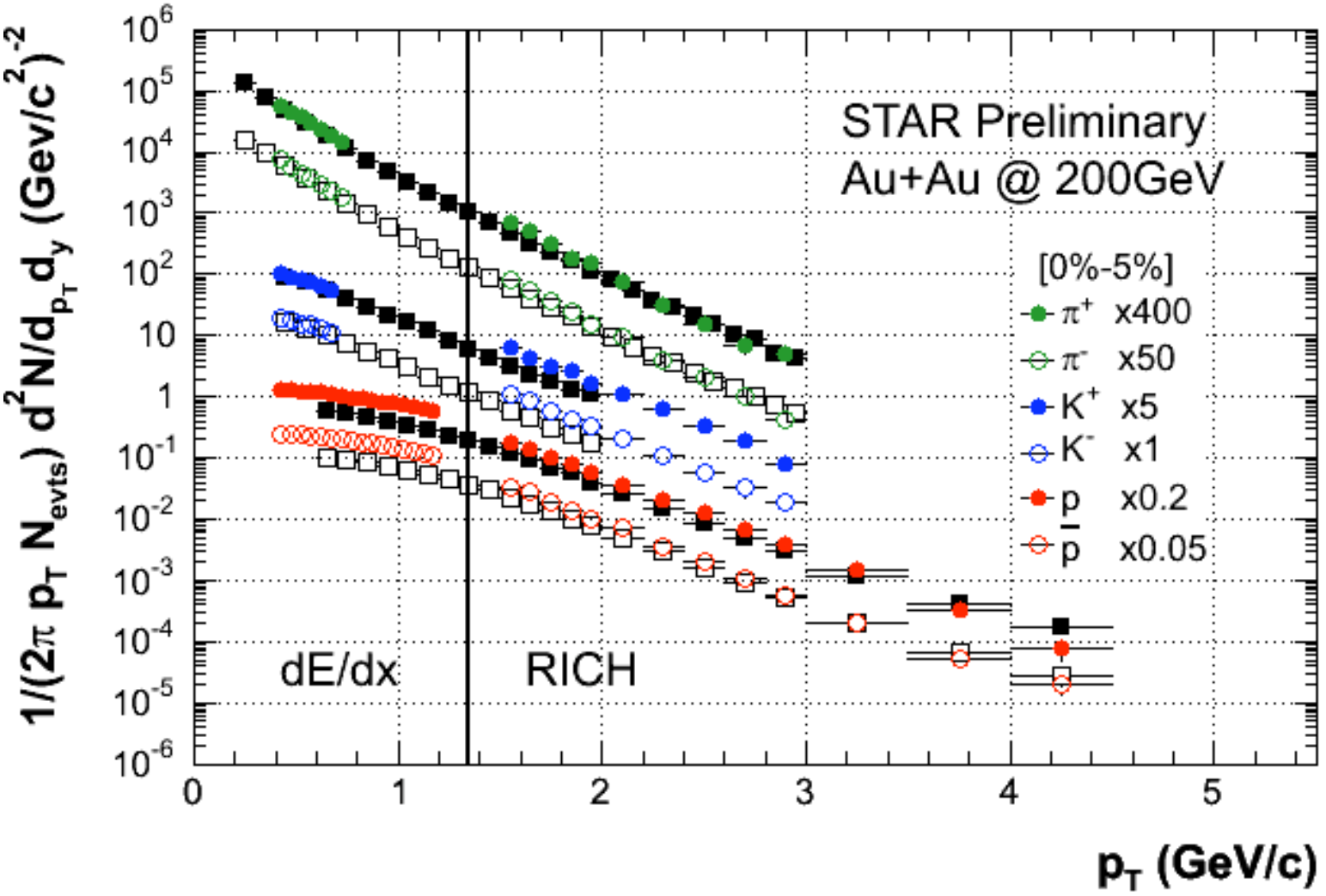
Integral method and Fitting

Cherenkov angle distribution in momentum bins





Comparison of Spectra with PHENIX



Current theoretical models

- **Soft+Quench Model** V. Greco et. al., Phys. Rev. C **68** (2003) 034904

  – Recombination of thermal and shower partons from a mini-jet.